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Q Fever in Canada

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ABSTRACT

A Canada-wide survey of Q fever was begun in 1958 in co-operation with public health and veterinary laboratories to determine the presence and prevalence of the disease so that medical practitioners might be alerted to the potential dangers existing. Serologic evidence obtained indicated that the Q fever rickettsia now exists in cattle in all provinces of Canada except New Brunswick, Nova Scotia, and Prince Edward Island. Isolations of the rickettsia were obtained from bovine milk samples from Ontario and Quebec. The data suggest that the etiologic agent was not present in the western provinces during the early 1950's but since having been introduced into that area it has established itself successfully, particularly in Alberta. The ease with which the disease in man may be missed is illustrated by a previously unreported case which occurred in 1960 in the Eastern Townships of Quebec.

SOMMAIRE

Une étude de la fièvre Q au Canada a été entreprise à l'échelle nationale dès 1958, en collaboration avec les laboratoires d'hygiène publique et les laboratoires vétérinaires. Elle avait pour objet d'établir la présence et la prédominance de la maladie au pays, de façon à aviser les médecins des dangers potentiels qu'elle comporte. Des études sérologiques ont montré que la rickettsie de la fièvre Q existe désormais chez le bétail de toutes les provinces, à l'exception du Nouveau-Brunswick, de la Nouvelle-Ecosse et de l'Ile du Prince Edouard. On a pu isoler la rickettsie dans des échantillons de lait provenant de l'Ontario et du Québec. Les renseignements obtenus permettent de croire que l'agent causal n'existait pas dans les provinces occidentales au début des années 1950, mais qu'y ayant été introduit par la suite, il s'y est solidement établi, surtout en Alberta. On peut trouver une illustration frappante de la facilité avec laquelle la maladie humaine peut échapper à l'attention du clinicien dans le rapport, non publié jusqu'ici, d'un cas qui s'est produit en 1960 dans les Cantons de l'Est de la province de Québec.

IN recognition of the increasing importance of Q fever as a world-wide endemic disease and of the necessity for clarification of its epidemiology, the Third World Health Assembly[16] in 1950 and the Joint WHO/FAO Expert Group on Zoonoses[18] in 1951 recommended that local and regional surveys be undertaken to determine the presence and prevalence of this disease in animals and man. Impetus was given to such a study in the United States through the development of an easily conducted serologic test, the capillary tube agglutination (CA) test, and provision of the necessary antigen to interested groups by Dr. L. Luoto[6] of the Rocky Mountain Laboratory, Hamilton, Montana. A report on that work was published in 1960.[7] In 1959, the Laboratory of Hygiene of the Department of National Health and Welfare, in co-operation with Dr. Luoto, undertook to promote and to participate in similar studies in Canada. At that time the provinces of Alberta and Saskatchewan had recently begun Q fever studies and we were able to enlist the assistance of groups in all of the remaining provinces. Milk and serum specimens from cattle were tested by the CA method employing *Coxiella burneti* phase I antigen made available until 1961 by Dr. Luoto. Antigen for the complement fixation (CF) test was a commercially avail-

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able product† prepared from the Nine Mile strain phase II. The following is a summary of the results obtained.

In the majority of provinces, the surveys were made by the provincial Departments of Health. In Manitoba and Alberta, the provincial Departments of Agriculture as well were involved. The survey in British Columbia was carried out by the federal Department of Agriculture.

The Laboratory of Hygiene, Ottawa, participated with the provincial Department of Health in a study of Q fever in Ontario. In 1961, we began testing bovine sera from the Province of Quebec, but this program as well as those in other parts of Canada had to be deferred when supplies of CA antigen were no longer available from the Rocky Mountain Laboratory. We then began production of the antigen at the Laboratory of Hygiene and, in response to requests, have been able to supply it to laboratories in various parts of Canada.

TABLE I.—OCCURRENCE OF *C. burneti* ANTIBODY IN CATTLE IN THE WESTERN PROVINCES

Province	*Period of testing*	*Material tested*	*Cattle tested*		*Herds tested*	
			No. tested	*No. and % positive*	*No. tested*	*No. and % positive*
British Columbia	1959 - 1960	Serum	18,211	439 - 2.4	2595	59 - 2.3
Alberta	Jan./59 - Mar./60	Milk			2354	18 - 0.8
	Apr./60 - May/61	Milk			1281	49 - 3.8
	June/61 - Nov./61	Milk			1022	69 - 6.8
Saskatchewan	1958	Milk			1101	0 - 0.0
	Dec./59 - Jan./60	Milk			1044	2 - 0.2
	Sept. - Oct./60	Milk			982	6 - 0.6
	April - May/61	Milk			837	5 - 0.6
	July - Aug./62	Milk			771	8 - 1.0
Manitoba	1960 - 1962	Serum	16,615	22 - 0.1	5540	3 - 0.1

The first Canadian survey of bovine Q fever was carried out in British Columbia by the federal Department of Agriculture from 1954 to 1957.[1, 13] In the procedure used, guinea pigs were inoculated with raw milk samples and at a later date they were bled and tested for antibody to *C. burneti*. These tests failed to indicate that Q fever was present in British Columbia cattle at that time. However, a survey carried out by Tailyour[17] from November 1959 to June 1960, using the CA method on bovine sera, revealed an animal reactor rate of 2.4% and a herd (premise) reactor rate of 2.3% (Table I).

In Alberta, examination of herd milks was conducted from 1959 to 1961. In the three periods shown in Table I there was a sharp increase in reactivity from 0.8% to 6.8% of the herds sampled. There were indications of herd-to-herd transmission through introduction of infected animals into previously negative herds.

In Saskatchewan, 1101 herd milks were tested and found negative in 1958. However, the 1959 to 1962 tests showed that Q fever had become established in dairy cattle in that province. The herd reactor incidence during the latter three-year period increased from 0.2 to 1.0%, still somewhat lower than the incidence in British Columbia and Alberta. One of the six herds positive in the September-October 1960 test was found negative in 1961, the sole seropositive cow in the herd having been slaughtered in the interim. Of the three newly positive herds in 1962, one became positive following the introduction of reactor "show" animals, while the other two herds were neighbours of previously positive herds.

A somewhat lower herd reactor rate was found in the adjacent province of Manitoba. A total of 16,615 individual bovine sera were examined.[5] The number of herds thus represented was not known exactly owing to the method of sampling, but Dr. J. M. Isa of the Manitoba Veterinary Laboratory estimated the number of herds sampled to be 5540. Twenty-two reactor animals were detected in three herds. Thus the individual reactor rate and the herd reactor rate were 0.1%.

Sixteen Regional Laboratories of the Ontario Department of Health participated with us in testing for bovine Q fever in Ontario.[11] The scattered locations of these laboratories made it possible to achieve good coverage of the milk producers of that province. Tested were 4567 herds, which comprised about 12% of all the dairy herds in the province (Table II). Of those tested, 103 herds

TABLE II.—OCCURRENCE OF *C. burneti* ANTIBODY IN MILK SAMPLES FROM DAIRY CATTLE IN ONTARIO, 1959 - 60

Regional laboratory reporting	*No. of herds tested*	*No. of herds positive*	*% herds positive*
Cornwall	110	0	0.0
Fort William	414	0	0.0
Kenora	108	0	0.0
Kingston	146	0	0.0
Kirkland Lake	74	0	0.0
London	355	3	0.8
North Bay	405	11	2.7
Orillia	158	14	8.9
Ottawa	733	0	0.0
Peterborough	375	53	14.1
Sarnia	97	6	6.2
Sault Ste. Marie	216	16	7.4
Stratford	104	0	0.0
Timmins	107	0	0.0
Windsor	777	0	0.0
Woodstock	388	0	0.0
Total or average	4567	103	2.3

†Lederle Laboratories, Pearl River, N.Y., U.S.A.

(2.3%) were serologically positive. Included in the 375 herds examined by the Peterborough Regional Laboratory were 87 herds from the Oshawa area where 31% were positive. Within these herds, the incidence of reactor animals varied from 11 to 47%, with a mean of 32%. Fish and Labzoffsky[4] have reported finding 7% of 200 herd milks collected in Western Ontario positive.

We have been fortunate in being able to conduct a survey of bovine sera from nine counties of the Eastern Townships of Quebec. These sera were made available to our laboratory during 1962 and 1963 by the Animal Diseases Research Institute of Hull, Quebec, after tests under the brucellosis control program had been completed. The Eastern

TABLE III.—OCCURRENCE OF *C. burneti* ANTIBODY IN CATTLE IN THE EASTERN TOWNSHIPS OF QUEBEC, 1962 - 63

	Cattle tested		*Herds represented*	
County	*No. tested*	*No. and % positive*	*No. tested*	*No. and % positive*
Bagot	4719	476 - 12.7	350	139 - 39.7
Brome	182	10 - 5.5	9	2 - 22.2
Compton	400	12 - 3.0	28	7 - 25.0
Missisquoi	193	28 - 14.5	10	7 - 70.0
Richmond	9470	836 - 8.8	447	186 - 41.6
Shefford	9436	733 - 7.8	481	183 - 38.1
Sherbrooke	1275	156 - 12.2	105	40 - 38.1
Stanstead	1366	87 - 6.4	68	26 - 38.2
St. Hyacinthe	1063	105 - 9.9	101	43 - 42.6
Total and %	28,104	2443 - 8.7	1599	633 - 39.6

Townships area is of particular interest because it is here that nearly all of Canada's recognized human Q fever cases have occurred. The total number of animals tested was 28,104, representing 1599 herds (Table III). Of these, 2443 sera from 633 herds were found positive. The reactor rate for individual cattle was 8.7% and for herds 39.6%

Herd milks have been tested by CA for Q fever in New Brunswick, Nova Scotia and Prince Edward Island (Table IV), and in each province the results

TABLE IV.—OCCURRENCE OF *C. burneti* ANTIBODY IN DAIRY CATTLE IN THE ATLANTIC PROVINCES

Province	*Dates tested*	*No. of herds tested*	*No. of herds positive*	*% herds positive*
New Brunswick	1960 - 61	693	6	0.0
Nova Scotia	1960	576	0	0.0
Prince Edward Island	1961	209	0	0.0
Newfoundland	1961	80	1	1.3

were negative. Testing in New Brunswick was carried out by three public health laboratories located at Campbellton in the north, Fredericton in the centre and Saint John in the south. The samples tested in Nova Scotia and Prince Edward Island were selected from well-distributed points and were considered representative.

The Public Health Laboratory in Newfoundland tested 80 herd milk samples (Table IV). Whereas results in the other three Atlantic provinces were negative, here a herd seropositive for Q fever was detected. The composite sample was submitted to our laboratory and its CA titre was found to be 1:32. We were able to obtain serum specimens from each of the 22 cattle in the herd.* The incidence of reactors within this herd was 31.8%, using the CA test, and 40.9% with the CF test which confirmed the finding from the composite milk sample (Table V). Inquiry revealed that the owner

TABLE V.—RESULTS OF Q FEVER TESTS ON SERA FROM CATTLE OF A NEWFOUNDLAND HERD FOUND POSITIVE BY THE CA MILK TEST

Serum	*CA titre*	*CF titre*
1	—	1 : 8
2	1 : 4	1 : 32
3	UND*	1 : 8
4	—	1 : 8
5	1 : 8	1 : 16
6	1 : 2	1 : 8
7	1 : 2	1 : 8
8	1 : 4	1 : 16
9	UND	1 : 8
No. of cattle examined	22	22
No. reacting	7	9
Incidence of reactors	31.8%	40.9%

*UND = Undilute.

had introduced cattle into his herd during the previous two years and that all of the animals introduced had been purchased in Prince Edward Island. The possibility that undetected Q fever is present in one or more herds in Prince Edward Island is being investigated.

PUBLIC HEALTH IMPLICATIONS

Although serologic evidence indicates that Q fever infection is present in cattle in seven of the 10 provinces, the number of reported human cases in Canada is small. The first recognized case occurred in 1955 in the Eastern Townships of Quebec and was reported by Marc-Aurèle, Grégoire and Comeau[9] in 1956. The patient was a farmer. In 1956, 62 cases occurred among the employees of an abattoir in the Eastern Townships. This outbreak was described by Pavilanis *et al.*[15] in 1958. Many of the herds from which cattle had been shipped to the abattoir during a three-week period prior to the outbreak were found to be serologically positive for Q fever. The only other cases reported in Canada were described by McLean, Rance and Walker[12] in 1960. These were a 3½-year-old girl and her 2-year-old sister who lived 30 miles outside Toronto.

Little information is available on the serologic status of Canadians. In a report published by Pavilanis, Lepine and Morisset[14] in 1952 it was noted that 4.6% of 218 persons living in the Montreal and Chicoutimi areas of Quebec province had Q fever CF antibody titres of 1:32 or more and that 9.2% had titres of 1:8 or more. None of the

*Samples kindly obtained by Dr. C. S. Button, Canada Department of Agriculture, St. John's, Nfld.

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students in tests conducted by Corrigan, Penikett and Williams[2] in federal boarding schools in Inuvik, Fort Smith, Fort Simpson and Fort McPherson, Northwest Territories, showed significant levels of CF antibody to *C. burneti*. In our studies[11] in the Oshawa area of Ontario, two of eight herdsmen and six of 875 hospital "routine" sera had CF antibody titres of 1:8 or higher.

In light of the findings here reported in cattle, one may question whether this is a true picture of the extent of Q fever in the human population of Canada. An unpublished case which occurred in Richmond County in the Eastern Townships of Quebec in 1960 illustrates how readily this infection may be misdiagnosed. The person referred to was a farm helper, aged 38 years, who since boyhood had worked as a casual labourer in the Eastern Townships. About the middle of November he became ill with what he thought was a common cold. He spent two days in bed and then felt well enough to do light work around the barns. He continued to feel below par for two weeks. On November 26 he was awakened early in the morning with severe pain in the left side of his chest. He consulted the family physician, who diagnosed his illness as a common cold. His condition did not improve and he was admitted to hospital in a nearby city on November 30. Radiographic examination showed pneumonitis at the base of the left lung and patchy involvement of the lower right lobe. He was discharged on December 13 with a diagnosis of bilateral pneumonia. However, a series of serum specimens, obtained from the time of his admission to hospital until January 9, was tested at the Institute of Microbiology and Hygiene, University of Montreal, and these sera revealed *C. burneti* antibody titres rising from 1:8 to 1:256.

We investigated the circumstances concerning this case in an attempt to find the source of the infection. All information indicated that the source had been the cattle on the farm where he worked. There had been no association during the previous 10 months with domestic animals other than those belonging to his employer. There had been no sheep on this farm for many years, and in fact no sheep were raised within a radius of five miles of the farm on which he worked. Individual milk specimens from the cattle with which he was associated were obtained in March following his infection, and it was found that 22% possessed agglutinins to *C. burneti*. Recently we isolated a strain of *C. burneti* from a cow on this farm by intraperitoneal inoculation of guinea pigs with a milk specimen and, after the guinea pigs had become febrile, transferring blood samples from them to embryonated eggs. As noted previously in Table III, our survey of cattle in Richmond County, Quebec, showed that 41.6% of herds were serologically positive for Q fever.

We have also isolated *C. burneti* from cattle in the Oshawa area of Ontario where the herd infection rate is high but where human cases are unknown. Preliminary observations indicate considerable difference between the infectivities of our two isolated strains for guinea pigs and we wonder whether the apparent difference in human infection rates in the Eastern Townships and in other areas in Canada may be attributed to strain differences, or to medical awareness, or to both factors.

Extensive testing of human sera with follow-up investigations of reactors will be necessary for an understanding of the public health significance of Q fever. The recent discovery in Great Britain of 13 cases of subacute endocarditis due to *C. burneti*, all of which were fatal, is of more than passing interest.[3] While convalescent sera of classical, uncomplicated human cases rarely fix complement with phase I *C. burneti* antigen, significant titres of phase I antibody were found to exist in eight of these cases. This led Marmion[10] to suggest that this test has diagnostic value for chronic infection with this rickettsia.

Discussion

The data collected in this study reveal that antibodies to *C. burneti* may be found in cattle in all provinces of Canada except New Brunswick, Nova Scotia and Prince Edward Island. In Newfoundland, only one seropositive herd was found. Of the remaining provinces with reactor cattle, Manitoba and Saskatchewan have the lowest incidence of seropositive herds. Then in ascending order are Ontario and British Columbia, next Alberta, and finally, with by far the highest herd incidence, the Province of Quebec. The data suggest that the inciting organism was not present in the western provinces during the early 1950's, but since being introduced into the area it has established itself successfully, particularly in Alberta. No statement can be made concerning the trend in Manitoba or Ontario, since follow-up surveys have not been made.

In the present survey of the Eastern Townships of Quebec, 8.7% of the cattle possessed *C. burneti* agglutinins, whereas some six years previously 4.7% had CF titres of 1:8 or higher.[15] While further testing is necessary to determine the trend in this area, these results, considered in the light of the high degree of correlation between the occurrence of CF and agglutinating antibodies found in cattle by Fish and Labzoffsky,[4] suggest that the incidence in this area is increasing only slowly. The isolation of *C. burneti* from cattle in Ontario and Quebec confirmed the identity of the agent inciting the serologic response, at least in these two provinces.

Lower infection rates in beef cattle than in dairy cattle can be expected, since beef cattle, which spend much less time in the close quarters of the barn, are exposed less often and less intensively to *C. burneti* aerosols from the after-birth and excretions of infected animals. According to Luoto and Pickens,[8] beef cows in Montana were rarely positive unless in close proximity to dairy premises. In

the present study, dairy cattle only were considered, except in Quebec, Manitoba and British Columbia. As regards Quebec, information enabling classification of the cattle tested is not available. It can be stated, however, that the area surveyed is predominantly a dairy cattle area. The number of beef animals included in the Manitoba survey was insignificant. In British Columbia an estimated 35% of the cattle tested were beef animals. It is interesting that the highest reactor rates observed were in the Fraser Valley and on Vancouver Island where only dairy cattle were tested.[17] Therefore it is probable that the incidence of reactivity in British Columbia cattle would be higher than that shown in Table I if the data were restricted to dairy cattle, and this statement may apply as well to Quebec.

The finding of a herd incidence of 39.6% in Quebec's Eastern Townships means that there exists on many farms the opportunity for persons associated with cattle to acquire the disease. While this seems to be a reasonable explanation for the occurrence here of all but two of the 66 recognized Canadian human cases, one might expect on this basis that cases would have been recognized in the Oshawa area of Ontario where a herd incidence of 31% was found. Observations such as these have led Luoto and Pickens[8] to conclude that something more than the mere presence of the agent in the environment is required for human involvement. Contamination levels necessary for the production of overt disease in persons living in rural areas may be unduly high and may occur only under extraordinary circumstances. Perhaps in some sporadic cases, influenza-like infections lower the resistance of the individual to a point where Q fever infection is possible.

SUMMARY

Serologic evidence resulting from surveys of cattle carried out in all provinces of Canada suggest that the rickettsia of Q fever is widespread, occurring in all but three provinces. The incidence of serologic reactivity in cattle is increasing in the western provinces and in Quebec. Repeat surveys will be necessary to determine trends in the remaining provinces. Isolations of *C. burneti* have been obtained from bovine milk in Ontario and Quebec confirming the identity of the inciting agent. All human cases of Q fever except two have occurred in the Eastern Townships of Quebec where the incidence in herds is high. Available evidence indicates that cattle infected with *C. burneti* were the source of infection of a previously unreported case which occurred in 1960 in the Eastern Townships. Serologic surveys of humans in Ontario revealed a low reactor rate.

The author wishes to express his gratitude to the many participants in this study and especially to those in Alberta, Saskatchewan, New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland who have generously consented to the use of as yet unpublished data. Thanks are also extended to Dr. A. R. Foley, Epidemiologist of the Province of Quebec, for help in obtaining information and specimens relative to the human case reported here from the Eastern Townships.

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PAGES OUT OF THE PAST: FROM THE JOURNAL OF FIFTY YEARS AGO

ONTARIO NEWS

An adjourned meeting of the Kenora town council was held on Tuesday, July 14th, when it was decided that a grant of $2,000 should be made to the Royal Jubilee Hospital, and of $1,000 to the St. Joseph's Hospital, the fact being taken into consideration that a large number of charity patients had been treated at both hospitals. The decision has aroused some dissatisfaction on the grounds that the St. Joseph's Hospital is a strictly sectarian and private hospital and therefore not entitled to a civic grant.

It has been decided that the four acres of land known as "Green bush" belonging to the Berlin and Waterloo hospital board is to be used as a public park until such time as it is needed for hospital purposes.

Two cases of smallpox have been reported in the neighbourhood of London. The source of infection, which is of the mild type, is unknown.

A fire which destroyed the convent adjoining the Hôtel-Dieu, Cornwall, recently, necessitated the hurried removal of many of the patients. The damage sustained by the hospital itself was, fortunately, slight.

The following officers of Nos. X, XI, and XIII Field Ambulances, with headquarters at Toronto, have volunteered for active service with the Army Medical Corps: Drs. T. B. Richardson, W. B. Hendry, G. A. Winters, W. H. Lowry, J. S. Boyd, H. L. Jackes, A. S. Lawson, H. Buck, D. W. McPherson, C. H. Gilmour, C. A. A. Warren, C. J. Currie, E. B. Hardy, A. G. Rice, H. R. Holme, W. H. Tytler, D. G. McIlwraith, W. Bethune, W. Carrick, D. A. McClenahan, H. Jones, R. R. McClenehan, J. A. Roberts, W. A. Scott, R. S. Penetecost, G. R. Philip, N. S. L. Yellowlees, W. T. McLean.—News, *Canad. Med. Ass. J.*, 4: 835, 1914.